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ABSTRACT

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EFFECTIVE DECISION MAKING WITHIN THE ORGANIZATION: A COMPARISON OF REGULAR, NGT, AND DELPHI GROUP PROCESSES

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A COMPARISON OF REGULAR, NGT, AND DELPHI GROUP PROCESSES

Abstract

Three group processes: regular face-to-face interacting groups, NGT (Nominal Group Technique), and Delphi procedures, were compared in terms of their ability to facilitate the quantitative and qualitative productivity of a decision-making group. The results unequivocally support the superiority of the Delphi procedure and tend to lend support to a general linear assumption which links face-to-face communication paradigms with an increase in interpersonal inhibitions and a concommitent decrease in creative problem-solution behavior.

Decision making is the quintessential function of any organization. Consequently, rapid, effective, and creative decision making processes are essential tools for managers. Any attempts, therefore, to serve management with the products of communication research and theory relevant to the decision making process must address the need for systems which enhance the quantity and quality of problem-solution proposals within a complex organization's decision making system. Toward that end, this paper offers some perspectives on the effacy of three alternative decision making processes.

In a nutshell, decision making can be dichotomized into individual and group processes. At one extreme the power figure at the top of a hierarchical pyramid can simply bite the bullet and make all relevant decisions with whatever resources he or she controls. The alternative, of course, calls for open and shared decision making systems centered in some form of group process. As with any dichotomy, however, there are distinct advantages and disadvantages to both systems.

Advantageously, an individual works in a judgement-free environment. As ideas are envisaged they are able to mature into viable concepts derived from a consistent logic. Because the task receives the undivided attention of the decision maker, there tends to be an increase in the specificity and quality of the decisions made relevant to that task. On the negative side, individual processes tend to bring the decision maker few interpersonal rewards. Good ideas receive little praise and bad ideas are angrily rebuked by the relevant others within the organization. Moreover, that anger is untempered by insight into the thinking which led to the decision. The data base upon which the decision must rest is limited to those resources processed by the individual and decisions arise from the perspective of just one indi-

vidual. As such, any dividends which might accrue from what Bormann (1975) or Shaw (1971) might term as an assembly effect bonus are missing in the final decision. And finally, implementation of the decision is hampered by the absence of nurtured commitments which could be fostered through the dynamics of a shared decision making process.

Perhaps two or more heads are, in fact, better than one. And yet, research on group-based decision making processes indicates that the use of committees, task forces, governing boards or similar groups to help generate decisions also has its cluster of problems. Perhaps the most devastating drawback to the use of committees is simply time. Van de Ven (1973) finds that as much as 80% of a program administrator's working time is spent in committee meetings. And yet, even this exhaustive investment in communication appears inadequate. The socio-emotional demands of group processes and the cumbersome decision-making system it characterizes is literally clogging the corporate machinery. Opportunity is lost, motivation gets dissipated. Ford (1978) emphasizes the harm done by slow cumbersome group processes by viewing them as variables affecting the tempo of an organization. He notes:

> This results in a corporate tempo that is too slow. Literally the pulse of an organization, tempo is the speed with which problems and opportunities are identified, decisions made and implemented, challenges met, and top management decisions translated into action. (p. 50)

Recognizing the critical import of decisions, however, it is clear that time, in and of itself, should not serve as a primary criterion variable to guide management to select between individual and group decision making processes. After all, if the group process invariably assured that superior decisions would be reached, organizations would be well advised to accept a torpid tempo. Choosing between individual or

group processes requires more than just decision time as comparison points.

Sherwood and Hoylman (1978) propose that "There are five factors to consider whenever one is faced with deciding whether to assign a particular task to an individual or a group of people for their joint consideration:

> The nature of the task itself; the importance of general acceptance of, or commitment to a solution for its implementation; the value placed on the quality of the decision; the competence, investment, and role of implementation of each person involved; and the anticipated operating effectiveness of the group, especially its leadership. (p3)

They suggest that individual decision making processes are superior to group based processes when (1) the task calls for creativity; (2) the quality of the decision is of paramount concern; (3) when relevent individuals are likely to bring excessive or task irrelevant conflicts into the process; (4) when implementation demands for probable solutions will exceed the competencies of the group members; and (5) when the potential group lacks adequate leadership to function effectively.

Viewed from the perspective of the group, this list by Sherwood and Hoylman would tend to suggest that one should only choose to use the group in decision making processes when outstanding people are available and when there is no need for high quality, creative decisions. Obviously, few managers would find such advice particularly useful. In the typical organizational system, many divergent specialties must be integrated, many critical decisions must receive the input of data and perspectives from members of professional staffs and external consultants. Quite simply, if the group is an inefficient, uncreative, and poor quality tool when applied to decision making processes, many

managers must feel compelled to continue its use simply for lack of a better alternative.

As might be expected, the pursuit of the "better alternative" has frequently been the focus of research efforts from persons of many disciplines. Currently, recommendations from research into the efficacy of group and individual processes remains ambivalent. Osborn (1957), as an early advocate of "brainstorming" or non-evaluative groups, suggests that "the average person can think up twice as many ideas when working alone" (pp. 228-229). Hall, Mouton, and Blake (1963) support this basic comparison of the brainstorming group and the individual. Even more significant, however, is the contention by Parnes and Meadow (1959) and Bouchard (1953) that the brainstorming group was able to generate significantly more ideas than a regular interacting group.

More recent research, however, has suggested that the face-to-face interactions bound up in group processes are so inhibiting that group decision making processes consistently produce results inferior to the productivity of individuals working alone (Bouchard, 1969; Bouchard and Hare, 1970; Campbell, 1968; Bunnette, Campbell and Jastaad, 1963; Taylor, Berry and Block, 1958). The nature of these inhibiting influences, the essential disadvantages of group processes as systems for creative and quality decision making procedures,are summarized by Van de Ven and Delbecq (1971) in the following eight observations about interacting groups. They propose eight variables to account for the apparent inhibiting effects of face-to-face encounters upon group decision making processes. Their list of inhibitors include:

1. A "focus" effect wherein interacting groups "fall into a rut" and pursue a single train of thought for longer periods (Dunnette, 1964; Torrance, 1957)

2. The "self-weighting" effect, wherein an individual will participate in the group to the extent that he feels equally competent with others (Kelly and Thibaut, 1954)
3. The fact that covert judgments are made but are not expressed as overt criticisms (Collaros and Anderson, 1968)
4. The inevitable presence within most organizational groups of status incongruities, wherein low-status participants may be inhibited and "go along" with opinions expressed by high-status participants, even though they feel their opinions are better (Vroom, Grant and Cotton, 1969)
5. Group pressures for conformity and implied threat of sanctions from the more knowledgeable members (Hoffman, 1965)
6. The influence of dominent personality-types upon the group (Dalkey and Helmer, 1963)
7. The amount of time and effort spent by the group to maintain itself (Dalkey and Helmer, 1963; Dunnette, 1964) As orientation to maintain group interaction increases, quality of solutions decreases (Campbell, 1968)
8. A tendency to reach "speedy decisions" before all problem dimensions have been considered (Maier, 1958)

(p. 296)

A perusal of this list suggests that the efficacy of group decision making prodedures would be assured if (1) the group adopted a rigid agenda and a time limit for the decision (Ford, 1978); (2) they could always be comprosed of cohesive and co-equal participants (Cohen, Whitmyre and Funk, 1960); (3) all judgment-- both verbal and nonverbal-- could be suspended during the transaction (Meadow and Parnes, 1959); (4) all participants could be encouraged or forced to ignore the source of ideas and evaluate ideas on their own merit (Dalkey and Rand, 1969); (5) all interpersonal power differences and future sanctions were suspended; (6) excessive talkers, high Machiavellian's or other dominent personality types could be managed; (7) the synergisitic demands of the groups' socio-emotional needs could be reduced (Baird and Weinberg, 1977); and finally, (8) all participants could be imbued with infinite patience and the organization could be allotted ample time to make sure that all possible issues have been

pursued before the decision is made. In effect, it is argued that the group could in fact fulfill the adage of "two heads being superior to one" if the basic group process undergoes rather drastic surgery.

Numerous researchers have experimented with various modifications of the traditional group process in an attempt to facilitate creative and high quality decision making by removing the inhibiting effects of judgmental comments and by increasing the overall involvement of the participants. Simon and Newell (1958) posit that there are two unique phases in any effective decision making process: the idea generation phase and the idea evaluation phase. A significant improvement in decision making effectiveness should occur if these two phases are kept temporally discreet. As an example, Meadow and Parnes (1959) were able to gain a significant increment in the quantity and quality of ideas by matching group participants according to age, sex and intelligence and by separating the "hypothesis formation" stages and the "judicial evaluation of the adequacy of hypotheses" by a full semester's time. The resultant small gain in group productivity attained by these elaborate procedures were likely enhanced by the fact that subjects received "a 30-hour training course in creative problem solving which utilizes Osborn's brainstorming and related methods" during the four-month period between the formation of hypotheses and the evaluation of the problem solution proposals. Clearly few organizations could replicate these complex participant control conditions or spare this amount of time for decision making processes. In fact, it is even doubtful that most organizations can

afford to impose a 30 hour course upon their staff.

Bouchard (1972) attempted to enhance the group process by modifying the basic brainstorming procedure according to the synectics procedures described by Gordon (1961) and Prince (1969). By focusing upon the involvement of subjects, Bouchard was able to generate group efforts which produced results superior to those produced by standard brainstorming groups. However, the synectics approach calls for group participants to create a "psychological identification" with the object or concept central to the problem being worked on. Operationally, Bouchard's instructions to subjects introduces the synectics principle with the following example:

> If the problem were, "Think up as many brand names as you can for a new spray deodorant" one of you would get up on the table, sit down, close your eyes, and play the can of deodorant (p. 419)

Quite obviously, if efficacious group procedures in the decision making process can only be attained through the introduction of highly unnatural role-playing activities, our defense of this communication context suffers. However, a cohesive, well-trained dyad ego involved in the topic will outperform individuals according to Cohen, Whitmyre and Funk (1960). Perhaps the key is for managers to create compatible working teams; to train these teams; and then to assign dyadic teams which evidence high ego involvement with the area of concern to function as decision makers for the organization. Whether the dyad is an appropriate operationalization of the "group" context is not quite clear at this point. Further research must be done to help us integrate these findings relative to dyadic groups

with those of Bouchard, Barsalous and Drauden (1974) who found that seven-person nominal groups outperform four-person nominal groups but there is no size effect for real groups. Even more importantly, however, we must come to grips with the overwhelming body of evidence generated during the last 20 years which plainly rejects the usefulness of regular interacting groups as a viable component of an organization's decision making procedures. In fact, Bouchard (1972) tersely states the status quo quite simply when he writes:

> Group problem solving is a procedure widely used in organizations, in spite of the overwhelming experimental evidence that indicates that individual problem solving is superior under most circumstances (p. 324).

In order for communication scholars to make a significant contribution to the decision making procedures of major organizations, it would appear that we must look beyond the regular interacting group as a salient communication context. On the other hand, recognizing the complexity of organizational systems and the need for pooled judgments and shared decision making processes, we can hardly endorse an autocratic mechanism characterized by an isolated individual who makes decisions without any input from colleagues or interested parties within or without the organization. Ideally, our solution to the quandry facing decision makers as they choose between the individual or the group must somehow integrate the two processes so that the manager is able to utilize the best strengths of both strategies. Two such integrated mechanisms, fortunately, exist.

The two decision making mechanisms being referenced here, NGT and Delphi, both strive to remove the inhibiting effects of groups interacting within a face-to-face context while continuing to accrue the advantages of pooled-thought processes so essential to many decision making contexts. NGT (Nominal Group Technique) was developed by Andre L. Delbecq and Andrew H. Van de Ven in 1968. At about the same time, Delphi was developed by Dalkey and his associates at the Rand Corporation.

Delbecq, Van de Ven, and Gustafson (1975) describe the NGT process as follows:

> NGT is a structured group meeting which proceeds along the following format. Imagine a meeting room in which seven to ten individuals are sitting around a table in full view of each other; however, at the beginning of the meeting they do not speak to each other. Instead, each individual is writing ideas on a pad of paper in front of him or her. At the end of five to ten minutes, a structured sharing of ideas takes place. Each individual, in round-robin fashion, presents one idea from his or her private list. A recorder writes that idea on a flip chart in full view of other members. There is still no discussion at this point of the meeting--only the recording of privately narrated ideas. Round-robin listing continues until all members indicate they have no further ideas to share. The output of this nominal phase of the meeting is a list of propositional statements usually numbering eighteen to twenty-five. Discussion follows during the next phase of the meeting; however, it is structured so that each idea receives attention before independent voting then takes place. Each member privately, in writing, selects priorities by rank-ordering (or rating). The group decision is the mathematically pooled outcome of the individual votes.

Dalkey (1969) describes the Delphi process in the following passage:

> The Delphi technique is a method of eliciting and refining group judgments. The rationale for the procedures is primarily the age-old adage "Two heads are better than one," when the issue is one where exact knowledge is not available. The procedures have three features: (1) Anonymous response -- opinions of members of the group are obtained by formal questionaire.

> (2) Iteration and controlled feedback-- interaction is effected by a systematic excecise conducted in several iterations, with carefully controlled feedback between rounds. (3) Statistical group response -- the group opinion is defined as an appropriate aggregate of individual opinions on the final round. These features are designed to minimize the biasing effects of dominant individuals, of irrelevant communications, and of group pressure toward conformity. (p.v.)

The key variable which these two group techniques have in common relates to the systematic reduction of face-to-face interactions and a concomitant reduction in the subsequent inhibiting effects of interpersonal judgments upon the behavior of the participants. The two techniques differ insofar as the NGT procedures allow for participants to be spacially interrelated much as a regular group might while the Delphi procedure totally abrogates the face-to-face aspect of the group. In keeping with the research reviewed above , therefore, it might be expected that the Delphi technique would produce consistently more ideas and consistently better ideas during a decision making process than the NGT technique. This follows because Delphi is more analagous to an individual process than the NGT procedure which continues to rely upon face-to-face encounters. And yet, the small amount of research which addresses this issue has not clearly supported this logical derivation of group vs. individual comparisons.

Gustafson et.al. (1973) compared individuals, regular groups, NGT groups, and Delphi groups on their relative abilities to accurately make subjective probability estimates. The NGT process was superior over all other processes and the Delphi procedure was the worst technique. However, the format utilized to conduct this particular Delphi process bears virtually no semblance to that procedure developed by Dalkey. In fact, Van de Ven and Delbecq (1974)in their review of the Gustafson

study, suggest that: "A possible explanation for the poor performance of the Delphi process my be that invalid experimental manipulations and testing were used (p.607)." This indictment gains support from the fact that Delphi has been demonstrated to be consistently superior to regular group processes when the task has involved the pooling of subjective estimates about the accuracy of a set of facts or about the probable occurrence of some phenomenon in the future.

Numerous results of experiments comparing the Delphi process with regular group processes indicate that Delphi is consistently superior as a decisions making tool (Dalkey, 1967, 1969; Dalkey and Helmer, 1962; Helmer, 1964, 1966; Campbell, 1966; and Dalkey, Brown and Cochran, 1969). In keeping with the general application of Delphi to projects designed to forecast the future, all of these studies compared the efficacy of various techniques upon the accuracy and creativity of estimates made by the pooled efforts of disparate experts. However, when Delphi is used to facilitate individual's interactions over solutions to emotionally charged problems such as the optimal format for forensics competition or the appropriate content for a job description the number of studies which support the superiority of this process are scant. Reinard and Crawford (1975) and Crawford (1976) provide some support for its usefulness as a pre-conference orientation device and offer some support for the efficacy of Delphi processes in decision making efforts bound up with emotionally charged issues. Additionally, one highly significant study designed to directly compare the three relevant processes has been conducted.

Delbecq, Van de Ven and Gustafson (1975) compared twenty regular groups, twenty, two-iteration Delphi groups and 20 NGT groups. Their results led them to make the following comparisons:

> Comparisons between the NGT, Delphi and interacting groups were based on the quantity of ideas generated and the immediate perceived satisfaction of participants with the decision making technique in which they had participated. Van de Ven (1974) found that the NGT and Delphi processes generated almost twice as many ideas as interacting groups, and that NGT groups generated slightly more ideas than Delphi groups. In terms of satisfaction, NGT group participants expressed a significantly higher level of satisfaction than did participants in the interacting and Delphi processes. Further, no significant differences were found in perceived group satisfaction between interacting and Delphi techniques (p. 19)

The superior productivity of the NGT group over the Delphi group, it would appear, poses a theoretic anomaly.

In keeping with the observation that the dynamic presence of others serves as an inhibiting effect during the decision making process, it should follow that the systematic reduction of interpersonal transactions would result in a concomitant increase in the quantity and quality of a group effort. The NGT procedures should facilitate decision making effectiveness because the initial generation of ideas is allowed to occure in the non-judgmental framework of an individual writing ideas down in private. In other words, when viewed from the perspective of problem solving theroists (Simon and Newell, 1958; Bales and Strodbeck, 1969), the primary advantage of both the NGT and Delphi procedures lies in their ability to separate the two unique phases of decision making processes: the idea generation phase and the idea evaluation phase. Moreover, since both techniques make it possible for participants to get controlled access to the thinking of fellow group members and

thus enable an assembly effect bonus to occur; since both groups maximize individual participation in both the generation and evaluation of ideas; and since both techniques make use of mathematical procedures to assure that the evaluations of each individual are accurately represented in the final outcomes, it should follow that both procedures would demonstrate similar advantages when they are compared to regular interacting groups relevant to the issues of qualitative productivity.

However, since Delphi procedures can be designed to maximize task-relevant interactions but totally abrogate the inhibiting judgmental processes inevitably bound up in face-to-face transactions by group participants, it should follow that the Delphi groups would generate significantly more and significantly better quality ideas relevant to a problem-solving task than either the regular interacting groups of the NGT groups. The fact that Van de Ven (1974) did not find support for this straightforward linear function might simply be an artifact of his operationalization of the Delphi experience. Because the choices one makes in designing a Delphi process are critical to its overall effectiveness, it is useful to review the operationalization of the Delphi procedures which contributed to Van de Ven's conclusion that the NGT is superior to Delphi.

Following Turoff's (1970) suggestion, Van de Ven (1973) set up his Delphi process to accommodate a two-iteration model and to structurally integrate the disparate efforts of three groups of individuals all performing different roles.

1. Decision Makers. This group works with the staff to create the

list of questions which will be used to stimulate and structure the Delphi participants' decisions-relevant statements of solution. In later rounds, they help decide upon the uniqueness and relevance of particular statements and thus influence the feedback offered up to the participants.

2. A Staff Group. These individuals assign participants to groups, design and supervise the dissemination and collection of all questionnaires, perform the mathematical operations on participants evaluations so as to define consensus and dissensus solution statements, and finally, they are responsible for interpreting all results to both the participants and the decision makers.

3. A Respondent Group . By Van de Ven and Delbecq's (1974) procedure, 140 individuals were invited to participate. They were assigned to one of 20 seven-person groups. From their perspective, the two-iteration Delphi procedure would appear as follows: A questionnaire arrives in the mail with the request that the individual "list the job activities that should be included in a job description of a House Fellow (Van de Ven, 1973,p. 613)." Several weeks later, a questionnaire arrived which contained a list of all ideosyncratic statements which were generated by the participants' group in round one. The request this time is to"choose the five most important job descriptions (Van de Ven, 1973,p. 613)." Several months after the receipt of the initial invitation, the respondent receives a final questionnaire which summarizes the results of

the groups' judgment and asks for their evaluation of the Delphi experience relevant to task and socio-emotional issues.

As an analogy of decision making realities within any major organizational system, the operationalization of Delphi utilized by Van de Ven and his associates simply violates the principles of isomorphism (see Kaplan, 1964, pp 263-264). In effect, it is unreasonable to propose Delphi as a decision making model when it vitiates participant involvement by requiring the establishment of three disparate groups; when it obviates meaningful participant interaction by utilizing only two iterations; and when it exacerbates the problems bound up with a decision making tempo which is already too slow in many organizations. In fact, one could hardly advocate a decision making procedure which required more than five months time to complete as did the Van de Ven operationalization of Delphi.

However, if Delphi is allowed to (1) maximize participant involvement; (2) facilitate participant interaction; and (3) occur in an expedient time frame, it should be possible to demonstrate its superior qualities as a decision making procedure. For the purpose of clarifying the importance of these operationalization issues and as a means of detailing our own Delphi procedures, each of these concerns will be reviewed in turn below.

INVOLVEMENT

If the basic decision making process of complex organizations is to maximize the efficacy and efficiency, of the decision makers, some significant changes must occur. Ford (1978) focuses upon this issue when he writes:

> The decision making process has probably received more attention from management scientists than any other subject. Yet in most companies it is still slow, cumbersome, and sometimes non-existent-- and to compound the problem, it excludes middle management from making vital contributions. MBO, grid systems and other techniques have simply piled one sophisticated process on another. The foundations for these techniques are wrong, and the system can never be more than minimally effective. Decision making will remain ponderous and middle management underused until we make some changes. (p.50)

For Delphi to make a significant contribution to this search for innovative decision making procedures, it is critical that it maximize the involvement of all participants-- decision maker and support staff combined. Involvement is hampered as a result of the Van de Ven procedures because the decision makers are isolated from the Delphi respondents. Recognizing the unique strengths of Delphi, namely that ideas are allowed to develop in a judgment-free environment and compete in an anonymous arena where status and personality traits can offer no artificial support for an idea, it would appear that the conscious integration of organizational status levels should be an integral part of any Delphi operationalization. In effect, Delphi optimizes democratic decision making models when properly designed.

From the perspective of the decision maker, participation in the Delphi process will facilitate involvement with the final decision.

From the perspective of the participants drawn from middle management or staff level positions, the very knowledge that they are full partners in the decision making process with representatives of all levels within the organization ought to optimize their sense of involvement with the task.

In a nutshell, it can be argued that Delphi should be managed by a professional message scientist who is independent from the power hierarchy of the organization. The Delphi supervisor should have the authority to demand the participation of all relevant members of an organization bound up within the parameters of the problem requiring a decision. Moreover, the Delphi supervisor should be able to identify the basic nature of the group itself though it is not necessary to specify all participants by name.

INTERACTION

When Delphi only makes use of two-iterations, any potential "assembly effect bonus" is vitiated by the fact that there is no opportunity to acquire cognitive stimulation from the inputs of others and thus be able to propose creative new solutions to a problem. In fact, the problem-solution proposals which result from a two-iteration process would hardly be expected to exceed the productivity of one intelligent individual's isolated effort.

Optimally, Delphi should utilize four iterations; however, at a minimum we prefer a three-iteration Delphi process which includes the following phases:

1. ROUND I - Parameter Development
Participants receive the following instructions:

Please write complete sentences defining what you feel should be in the basic job description of the student assistant dormitory counselors. Even if you will not be living in the dormitories, please contribute your ideas.

Consider academic, moral-ethical, and social concerns in your list of ideas. For example, SAs should set a good example for students.

Please write as many of these job description guidelines down as you can.

2. ROUND II - Position Development
The instructions appear as follows:

Below are all of the statements you and the other five persons in your group generated last round. We removed duplicate statements and worded all sentences in a positive style so they would be easy to compare. YOUR TASK. A) Rank the top TEN items using #1 to indicate the statement you consider to be the most important consideration for an SA's job description. B) Write a brief justification in one or two sentences for each of those items you ranked 1-5. Please add any statements not included that you think important.

3. ROUND III - Evaluation
The final questionnaire contained the following instructions:

Below are the statements that your group generated in rounds 1 and 2. The first ten statements are the ones that were ranked most important as a group. Please read all the statements again along with the justifications. Then re-rank, choosing the 10 statements you feel are the most important for an SA's job description.

(Also included with Questionnaire III was a one-page evaluation sheet which elicited subjects' attitudinal responses to the Delphi procedure.)

EXPEDIENCY

A final and very critical issue relevant to the Van de Ven interpretation of Delphi has to do with the cost and speed with which he conducted the two-iteration process. An abbreviated summary of the Delbecq, Van de Ven and Gustafson (1975) table of comparisons for the three-group processes emphasizes the fact that their interpretation of Delphi tends to mitigate against its usefulness. They make the following comparisons:

	Interacting Groups	NGT Groups	Delphi Groups
Administrative working time	84 hours	88 hours	141 hours
Administrative costs	$220	$230	$440
Completion time	4 evenings	4 evenings	5 months
Participant time	90 minutes	90 minutes	30 minutes

Offered up to management, this table of comparisons would virtually mandate that the NGT procedure be preferred over the Delphi procedure because similar gains in decision-making efficacy could be attained with the two processes but the NGT process accrues the benefits for half the cost in administrative time and money while using only three times as much employee time. Moreover, one might hardly be surprised that the overall efficacy of Delphi tends to pale in comparison to NGT procedure when one considers that the respondents devote two 15-minute efforts to a task in sequences separated by a five-month lag time. In fact, it would take a remarkable devotion for an

individual to maintain an interest in or commitment to any problem for almost half a year. Again, a corporate decision maker might feel hard pressed to justify Van de Ven's Delphi procedure as a useful innovative tool with the capacity to serve the goal of increasing decision making tempo.

One goal of this paper is to demonstrate that Delphi is a pragmatic and productive tool which can readily be incorporated into the decision making procedures of any organization. Our Delphi procedures are designed to be analogous to any large organization wherein the relevant decision makers tend to be contiguous to one another. In other words, where Van de Ven used the mails to carry out his Delphi, our procedures utilized a personal delivery system much as one might expect a major organization to utilize the inter-office memo system to link members of an organization. In this sense, our Delphi procedures are more analogous to a field application situation than is the Van de Ven model.

Specifically, we delivered the questionnaires to the Delphi respondents at their homes and picked them up in the same fashion. Our entire three-iteration process required less than $10 and three days to complete. The administrative demands involved in preparing the questionnaires did not cause the researchers any excessive time. In fact, the amount of time involved in the various face-to-face group meetings probably exceeded the total amount of time which was devoted

to the administrative details inherent in running the three-iteration Delphi. We did not, however, attempt to quantify the issue of administrative effort because such quantifications would be highly susceptible to manipulation and error.

By way of summary, it can be noted that the operationalization of Delphi bound up in a three-iteration process allows the researcher to claim that Delphi maximizes the creative potential of participants by totally removing the inhibiting effects bound up with face-to-face interactions. At the same time, the Delphi procedures facilitate the possibilities of an assembly effect bonus by making it possible for the thought processes of one individual to stimulate creative problem-solving proposals by another individual. And finally, the mathematical processes of judgment assures that the final product of the procedure optimizes the equality and the participation of all participants. As such, the following hypotheses can be advanced.

DECISION MAKING PRODUCTIVITY

Maier (1964) and Maier and Hoffman (1964) point out that the more ideas one generates the greater the number of ideas which can be considered in making the decision and consequently, the greater the likelihood that the decision will be creative and useful. Keeping this notion in mind, we can postulate that the Delphi procedure will maximize the creativity of decision making processes. Specifically, two hypotheses can be advanced: one related to quantity of task relevant effort and the other related to the quality of that effort.

H_1 Participants in the Delphi process will generate significantly more proposals to solve a problem than will participants in either an NGT format or an interacting group process.

In keeping with the linear nature of the advantage claimed by the systematic reduction of face-to-face inhibitions, a corollary hypothesis can be advanced:

H_{1a} Participants in the NGT process will generate significantly more proposals to solve a problem than will the participants in an interacting group process.

Both of these hypotheses will be tested by a one-way analysis of variance. The confidence level chosen for the acceptance or rejection of all hypotheses is set at .95.

DECISION MAKING QUALITY

H_2 The quality of the problem-solution proposals generated by the Delphi participants will be judged to be superior to those generated by participants in either an NGT format or an interacting group process.

Again, because the inhibitions bound up with face-to-face interactions are assumed to operate in a linear fashion, a corollary hypothesis can be offered to account for the performance of the regular group participants relative to those individuals allowed to meet face-to-face but structured by the NGT procedures:

H_{2a} The quality of the problem-solution proposals generated by the NGT participants will be judged to be superior to those generated by participants in the interacting group process.

SOCIO-EMOTIONAL SATISFACTION

A final concern for most researchers who focus on group processes has to do with the feelings of the participants. Quite simply, the argument is made that persons will not implement or support a decision

if they perceive the decision to be invalid. As such, it is relevant to any decision making process that persons feel essentially satisfied with the decision making process (Bass, 1970; Dalkey and Helmer, 1963; Van de Ven and Delbecq, 1974).

Assuming that the greater the quantity of verbal interaction the greater the opportunity for individuals to establish satisfactory human relationships and a sense of self worth, it can be reasoned that Delphi contributes very little to this dimension of the decision making process. As such, the following hypotheses relevant to the socio-emotional dimension of group relationships can be postulated:

H_3 Individuals participating in face-to-face interacting groups will express significantly more satisfaction with the group process than will individuals in either the NGT or the Delphi groups.

However, because the NGT procedure does not totally remove the face-to-face encounter of the participants it can be expected that the following corollary hypothesis can be advanced to support the essential linearity of satisfaction as a dependent variable of unrestricted face-to-face interactions:

H_{3a} Individuals participating in NGT groups will express significantly more satisfaction with the group process than will individuals in the Delphi groups.

METHOD

Subjects

Fourty-five freshman subjects selected from the Summer Orientation program at a midwestern university were invited to participate in one of three groups: regular interacting groups, NGT (Nominal Group Techniques) and Delphi groups. Subjects were assigned to five-person groups and randomly assigned to one of the three conditions.

Procedures

Regular group. Five subjects assigned to the regular groups were seated at a table, introduced to each other, and requested to work as a group to prepare a list of recommendations as to guidelines which should be included in the job description of a Student Assistant in the dormitory. One individual was asked to serve as a secretary. When the group had proposed as many statements as they were able to, they were asked to record them and then complete a series of Semantic Differential scales and eight Likert-type scales designed to measure the general satisfaction of the participants in the overall group process and the list of recommendations they had prepared.

Nominal Group Technique. Five subjects assigned to the NGT groups were seated at a table and introduced to each other. They were requested to spend 7-8 minutes silently writing down all statements they could think of which should be included in the basic job description of a Student Assistant dormitory counselor. To help stimulate their thinking, they were asked to consider academic, moral-ethical, and social issues.

At the end of the silent writing period, all ideas were elicited from the participants in round-robin fashion and were recorded on the blackboard. Individuals were encouraged to create new ideas as this procedure was taking place whenever they thought up recommendations which were not yet represented by the material on the board. When all material was written on the blackboard, the participants were asked to discuss all items which they felt would benefit from clarification. The wording of items could be changed at this time to enhance the clarity of the recommendation.

When all items were adequately understood, participants were asked to rank order the items by identifying those which they felt fell in the top ten. The results of 11 rankings were computed and the group consensus was mathematically defined as a simple function of composite evaluation scores. Before the participants were dismissed, they were asked to discuss the rankings and justify changes

in the emerging priority scheme as they saw fit. Following this discussion, the participants silently engaged in a final rank ordering procedure and then completed the attitude scales.

Delphi Groups. These subjects were contacted in their homes and assigned to groups by the researchers. Within an hour of their acceptance of the invitation to participate, they received the first questionnaire (the Delphi Questionnaires have been thoroughly reviewed elsewhere). The completed questionnaire was picked up the following morning and the second questionnaire was placed in their mailboxes before five o'clock that evening. The morning of the second day, questionnaire II was retrieved and questionnaire III was delivered before five o'clock on the evening of that second day. By noon of the third day, all of the data was collected.

Along with the third questionnaire, subjects received the process evaluation sheet and were able to supply information as to the relative satisfaction they experienced as a part of the Delphi procedure.

Statistical Analysis

The first hypothesis was tested with a one-way analysis of variance at the .05 level of significance. The dependent variable relevant to productivity was computed by counting the discreet number of statements which were produced by each of the nine groups.

The second hypothesis relevant to quality was tested with a chi square analysis. The dependent variable was compiled from the ratings of housing officers and senior dormitory residents who served as judges. The judges were asked to place the lists of recommendations generated by the nine groups in one of three piles. The three piles were intended to represent judgments of superior quality ideas, typical suggestions and recommendations of little utility.

The third hypothesis relevant to the participants satisfaction with the recommendations they had generated was tested with a one-way analysis of variance where the dependent variable was the mean response behavior of group participants relevant to nine bipolar adjective pairs (good/bad, useful/useless, important/unimportant, meaningful/meaningless, true/false, positive/negative, strong/weak, cautious/rash, and sensitive/insensitive). These items were selected as contributors to a unified attitudinal measure because they had narrow standard deviations and relatively large estimates of communality. The subject population was too small to enable a stable factor solution to justify the selection of adjective pairs by any other criterion.

In addition to the participants evaluations of the recommendations themselves, the socio-emotional satisfaction of the participants relative to the different group procedures was explored by a series of one-way analysis of variance upon each of eight Likert-type statements. The eight statements were generated in order to evaluate participants responses to issues identified as relevant areas of difference between the three group procedures in the research by Delbecq , Van de Ven and Gustafson (1975).

The statements followed by five-space agree/disagree scales, included the following:

I feel satisfied that my contribution to the group was important.
I feel satisfied with the way our meeting was run.
I feel satisfied with our group's ability to get the job done.
I feel satisfied with the social interaction that took place in our group.
I feel that everyone in the group participated equally.
I feel that disagreements were handled well in the group.
I feel our group accomplished the task at hand.
I felt highly motivated to do my best in this experience.

RESULTS

H_1 & H_{1a}

The first hypothesis received unequivocal support. The following table of means apparently reflects a difference in the quantity of ideas generated by the three decision-making procedures which could occur by chance once in less than a thousand times.

Means Table

	Regular Groups	NGT Groups	Delphi Groups
Mean No. of Ideas S.D.	9.47 (.915)	17.33 (.488)	26.93 (3.149)

F Table

SOURCE	DF	Sum-of-squares	Mean Squares	F Ratio	Probability
Between Groups	2	2211.16	1105.08	314.775	.0000
With Groups	41	144.00	3.51		

H_2 & H_{2a}

The second hypothesis receives equivocal support. The qualitative superiority of the recommendations made by the Delphi participants is affirmed beyond chance but the corollary hypothesis which supports the linearity of our theoretic assumptions fails to garner support. In fact, the recommendations generated by the NGT participants were adjudged to be inferior to those generated by the regular group. The following table of observed frequencies and row percentages indicates the nature of this equivocal support for the hypotheses concerning the quality of the relative group efforts.

Chi Square Distribution

	Superior Quality	Average Quality	Inferior Quality
Regular Groups			
observed frequency	4	15	11
Row percentage	13.33	50.00	36.67
NGT Groups			
observed frequency	7	10	13
Row percentage	23.33	33.33	43.33
Delphi Groups			
observed frequency	16	5	9
Row percentage	53.33	16.67	30.00

Chi Square - 14.39, d.f.=r Significance = .006

H_3 & H_{3a}

Taken together, these two hypotheses predicted that the systematic reduction of face-to-face interactions in group procedures would produce a diminished sense of socio-emotional satisfaction among group participants. The results of analysis on two kinds of dependent variables offers insignificant trend support for this notion. When subjects attitudinal orientations toward the quality of their proposed list of recommendations is taken into consideration, the direction of the participants mean attitudinal response scores supports the hypothesized relationship but the numbers could easily have occurred by chance alone. The following means table, therefore, should be considered merely as a suggestion of trends.

	Regular Groups	NGT Groups	Delphi Groups
Mean Attitude Scores & S. D. 's	2.15 (.79)	2.25 (.66)	2.42 (.48)

Critical F = 3.23, Observed F = .63, Significance = .53

In addition to the relatively general measure of participant satisfaction afforded us by the responses to the nine semantic differential scales, we also have subjects responses to eight Likert-type statements on five point agree-disagree scales. Reviewed within the framework of a 3 x 8 matrix, it becomes clear that the hypothesis regarding a linear decrease in participant satisfaction brought on by the systematic reduction in face-to-face interaction receives equivocal support. Moreover, only three of the observed response patterns occurred in the manner listed here beyond the .05 level of probability. For purposes of brevity, the three significant response patterns are noted with an asterisk.

STATEMENT	REGULAR	NGT	DELPHI	F-PROBABILITY
I feel my contribution was important.	1.93 (.79)	2.00 (.84)	1.71 (.61)	.57
*Our group got the job done.	1.66 (.97)	1.47 (.74)	2.28 (.72)	.02
Our meeting was run well.	1.86 (.91)	1.60 (.63)	1.92 (.73)	.47
*Our group had a good social interaction	1.60 (.50)	1.66 (.81)	3.00 (.78)	.0000
Everyone participated equally.	2.26 (.88)	2.06 (.136)	2.28 (.99)	.83
*Disagreements were handled well.	1.73 (.88)	1.86 (1.06)	2.85 (.36)	.001
We accomplished the task at hand.	1.86 (.91)	1.60 (.63)	1.71 (.72)	.63
I felt motivated to do my best.	1.93 (.70)	1.66 (.72)	2.28 (.99)	.13

DISCUSSION

The study reported here derives its hypotheses from a relatively straightforward linear assumption that one can improve the quantity and quality of a group's decision-making productivity by systematically removing the inhibiting effects of face-to-face interaction from the group process. Left unregulated, a regular group process will produce few ideas and fairly poor quality ideas because of a combination of inhibiting variables which might include a) getting in a rut; b) reticence to participate by low power individuals; c) a fear of negative judgment by the fellow group participants; d) a tendency to conform to the opinions of high-status individuals; e) a basic distortion of judgment brought on by pressures to conform to group opinions; f) an undue amount of influence or dominance by competitive personality types; g) a felt need to invest more energy in the maintenance of the group or the fulfillment of individual's socio-emotional demands than in the task relevant problem-solution activities; and finally, h) a tendency to climb on a bandwagon and reach decisions before the problem has been adequately developed.

Seeking a decision-making process which could enhance the productivity of individuals and affirm the adage that "two heads are better than one", we reviewed some basic alternatives to the regular interacting group. Two such alternatives were identified: the Nominal Group Technique and the Delphi technique. However, the only significant piece of research which has been done to date that systematically compares the three processes operationalized Delphi in such a fashion as to virtually

assure its inferior performance relative to the NGT procedures. Consequently, an effort has been made to essentially replicate the pioneering work of Van de Ven and his associates but to optimize the Delphi procedure so as to assure that both the NGT and the Delphi processes maximize the involvement of individual participants in the decision-making process while also expeditiously maximizing the non-judgmental interactions between participants over the task at hand.

The three iteration Delphi process employed in this research unequivocally emerges as the most productive decision-making model. Not only does the model allow participants to obtain superior quantitative and qualitative outcomes within a decision-making activity but it achieves these gains with minimal decreases in the overall levels of satisfaction by the participants. In fact, participants in all three decision making processes esentially express a high level of satisfaction with the list of recommendations that their groups generated (the overall mean was 2.27). More specifically, the Delphi participants tended to agree more strongly with the statement "I feel satisfied that my contribution to the group was important", than did any other group. Though the differences on this item were not significant, the mean score of 1.7 on the 5-point scale is a clear indication that Delphi tends to maximize participant involvement.

Of the three Likert-type items which elicited responses that reflect significant differences in behavior, they all support the general hypothesis that the total removal of face-to-face interactions from decision making processes tends to diminish socio-emotional satisfaction among the participants. The first significant statement, "I feel satisfied with

our group's ability to get the job done", reveals that the NGT participants agree with that notion strongest (1.46), followed by the Delphi group (2.28). Perhaps, one artifact accounts for the rather pervasive dissatisfaction with the overall task performance by the Delphi participants. Namely, by using a three-iteration process, the participants never saw the final results of their effort and thus never had an opportunity to adequately evaluate the ability of their group to get the job done. In future research, a four-iteration Delphi should be utilized so that this alternative explanation can be tested directly.

The statement, "I feel satisfied with the social interaction that took place in our group", was the second Likert-type statement that generated significant differences in response behavior. Note, however, that the NGT group (1.66) and the Regular group (1.60) have virtually identical responses to this notion. Quite apparently, face-to-face interaction tends to constitute a sufficient and necessary condition for fundamental socio-emotional gratification. The relevant variance in this particular instance is contributed by the Delphi participants. Virtually all participants marked the neutral response in relation to the notion of social interaction simply because they had absolutely no social interaction to evaluate.

The final Likert-type statement which garnered significant differences in response behavior related to the notion of conflict management: "I feel that disagreements were handled well in the group". As might be expected, the Regular group (.173) indicates the greatest tendency to

agree with this statement. However, the poor productivity of the group might suggest that the primary means utilized by the Regular group participants to manage conflict was simple capitulation. On the other hand, the NGT participants evidence a dramatic increase in productivity with only a minor increase in apparent conflict (1.86). The non-judgmental idea generation procedures and the compulsory round-robin technique for eliciting imputs apparently garners significant advantages relevant to productivity with minimal tradeoffs relative to group conflict. The Delphi response (2.85) quite probably reflects the judgment that conflict was an irrelevant concept for that particular group process rather than the notion that the conflict which did emerge was poorly handled.

In a nutshell, we feel that Delphi emerges as a dramatic and rather innovative decision-making tool with tremendous potential in any complex organizational context. Delphi can be conducted rapidly, 3 to 4 days, cheaply, and productively. In fact, Delphi requires less actual time from the participants than the other two processes (45 minutes vs. 60). Moreover, the participant can devote his/her energies to a Delphi questionnaire whenever a busy schedule permits, and thus the actual gain in efficient use of employee time may be greater than we imply. But most significant is the overall gain in the quality and quantity of participant productivity which is garnered by the use of Delphi. In the age of ever-increasing system complexity, the advantage accrued by an efficient and qualitatively superior decision-making process can scarcely be estimated.

As a recommendation to organizational managers, we propose that they plan to make use of trained message scientists as integral components of the management team. This individual would bear the responsibility for managing Delphi projects, of course, but their general utility would be as broad as the discipline of communication is rich. In fact, a skilled communication scientist has the capacity to engineer functional message systems which can facilitate a whole host of critical outcomes relevant to the needs of an organization.

Future Research Concerns

We are concerned with the apparent lack of socio-emotional satisfaction which is generated by the Delphi process. Though the evidence tends to suggest that the drop in commitment to the solution or the absence of cohesion within the group might produce few harms, it would nevertheless be useful to mitigate these drawbacks and insure that a Delphi procedure is allowed to maximize its potential as a functional tool for management.

Reinard & Crawford (1975) and Crawford (1976) have used a Delphi as a pre-conference planning tool. The Sedalia National Developmental Conference on Forensics obtained dramatic benefits from this use of Delphi because the participants arrived with a detailed list of critical areas of consensus (areas in which extensive discussion would merely constitute a reinforcement exercise) and areas of "dissensus" (areas where productive discussion might generate functional compromise). This six-day conference was able to generate a list of recommendations of

remarkable breadth and developed a level of intense commitment among all the participants in part because they had the clear foundation provided by Delphi to get them oriented. An anecdote from the conference clarifies this point: Members were observed referring to their Delphi summary sheets and debating issues during the registration period. Even on the first night of the conference, the level of involvement among participants was little short of remarkable.[1]

In future research, we would suggest that researchers plan a four-iteration Delphi process and then conclude the problem-solution activities by having a face-to-face conference which utilizes some of the more significant components of the NGT procedure. Having everyone generate comments in a round-robin sequence and utilizing a mathematical procedure to aggregate evaluations of problem-solution recommendations seem particularly useful to us. Our assumption is that this combined problem-solution process would generate task and socio-emotional outcomes which would exceed the general advantages of Delphi alone.

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[1]This is a rough paraphrase of some comments made to Reinard and Crawford by several of the participants at the Sedalia Conference.

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